

Research Project Overview

This semester you have the opportunity to do real scientific research. This could be the first time you have engaged in research in your college experience, but even if you have already done some research, our goal is for you to walk away from this project with a deeper understanding of surface water and groundwater, as well as of what doing science is really like. The research you will be working on is part of a long-term project to monitor the water system in the Ames area. Your data will be used by students in following semesters and by scientists, so **it is important that you gather quality data.**

A quick overview:

You and your group will design a research project that explores a research question and hypothesis regarding groundwater, surface water, or both that you have created. The culmination of this project will be a poster session at the end of the semester. At this session you will present your research to other Geology 100L students, Geology graduate students, Iowa State faculty, and the Dean of the LAS College. Students who have previously taken the lab have found this event to be a very rewarding experience.

You will complete many of the components of the poster as the semester progresses. If you keep up, putting your poster together at the end of the semester should be very doable.

More details about the poster can be found in the Poster Overview document.

The Geology Department will print your poster for free if you submit it on a flash-drive by the Final Draft due date listed above. If your group does not meet that deadline, you will be responsible for printing your poster and covering the cost.

Grading for the research project is as follows:

| | <i>Points</i> | <i>Individual or Group Grade</i> |
|--------------------------------|---------------|----------------------------------|
| Brainstormed Research Question | 5 | Individual |
| Proposal | 15 | Group |
| Abstract & Peer Review | 15 | Group |
| Poster Presentation | 5 | Individual |
| Poster Content (TA + Judges) | 40 | Group |
| Attending Poster Session | 5 | Group |
| E-mailing TA data + poster | 5 | Group |
| Group Evaluation | 10 | Individual |
| Total | 100 | |

Expectations

It is expected that you participate fully in this research project. You will be working in a research group of 3-4 students. Each student is expected to contribute to the group's work. Your group members will evaluate your contributions at the end of the semester and this will be taken into account when your grade is calculated.

We expect you to produce professional and original work. It may be necessary for you to read relevant literature (i.e., scientific journals) in order to complete your project. Iowa State University Academic Dishonesty policies will apply to this presentation and plagiarism and cheating will be reported to the Dean of Students' office.

Research Question and Hypothesis Overview

Curiosity and creativity drive the scientific world. Science allows us to ask questions about things in the natural world that we don't understand. At the heart of every research project is a research question. How can we better deliver vaccines? How does tiling fields affect Iowa rivers? What caused a mass extinction in the Earth's past?

Your group needs to create a research question you would like to study. What do you want to know about Squaw Creek and the groundwater system surrounding it? Do you want to study water quality? Water levels? Stream flow? Precipitation? The choice is yours.

Early in the semester, you will go out to the well field to familiarize yourself with the equipment and a few groundwater concepts. Your homework for that lab will be to come up with two research questions you think would be interesting to look into for the research project. You will submit these to your TA on Blackboard and they are worth 5 points. The next week the class will discuss and brainstorm research questions together.

You and your group will then have two weeks to explore one research question by completing a "mini-project" using the stream table and ant farm models. You can consider this as practice for the main research project that spans the whole semester. After this mini-project, your group must develop a research question for the semester project.

The next step is to develop a hypothesis. A hypothesis is a testable statement about the natural world that is based upon observations. Based upon the information you have gathered from your field exercise and the stream table and ant farm models, you now can come up with a proposed hypothesis within your research question.

For example:

A potential research question could be: *At what stage/elevation does the stream need to be for bank storage to occur?*

The hypothesis that would answer this question could look something like this: *Bank storage occurs when the Squaw creek reaches an elevation of 880ft.*

Hypotheses need to be specific and testable. The above hypothesis is specific because it gives a set elevation that bank storage will occur. A specific hypothesis could include a range of values, or an effect as well. The above hypothesis is also testable. The elevation of the Squaw Creek can be measured, and bank storage can also be measured.

Research Question, Hypothesis and Plan of Attack Rubric

| | Much improvement needed (0 pts) | Needs some improvement (1 pt) | Ready for field work (2 pts) | Points |
|--------------------------------|---|---|---|--------|
| Research Question | Not specific, testable, or feasible. | Needs to be more specific and/or testable. | In a question format, specific, testable, and feasible. | |
| Hypothesis | Not specific, testable, or feasible. Absent or missing. Not related to the research question. | Needs to be more specific and/or testable. Not necessarily clear how it relates to the research question | Specific, testable, and feasible and related to the research question. | |
| Plan of Attack (Research Plan) | Does not contain specific information about what data is needed nor how it will be collected. | Contains information about what data is needed, but not necessarily specifics about how or when it will be collected. | Contains information about what data is needed, how the data will be collected (equipment), and how often the data will be collected. | |
| Thoughtfulness and Creativity | Lacking thoughtfulness or creativity. The research question and/or hypothesis have been previously researched and accepted by the scientific community. Any relationships (eg. the relationship between groundwater and surface water) are ignored. | Some thoughtfulness or creativity. Some components of the research question and/or hypothesis are well accepted by the scientific community. The research question and/or hypothesis explore a simple relationship present in the system. | Group shows thoughtfulness and creativity in putting together the research question, hypothesis, and plan of attack. The research question and/or hypothesis explore an area not well accepted or researched by the scientific community. The research question and/or hypothesis explore a complex relationship present in the system. | |

What is an Abstract?

An abstract is a short statement about your research designed to give the reader a complete, yet concise, understanding of your findings. It is a mini-version of everything on your poster.

What is the Purpose of an Abstract?

A well-prepared abstract allows a reader to quickly and accurately identify the basic content of your poster. Abstracts for papers published in journals allow readers to read the abstract and see if the related research is of interest to them.

What should be in an Abstract? How is it structured?

Your abstract should contain the following elements:

1. **The big picture:** What question are you trying to answer? What is your hypothesis? Why is your question worth answering?
2. **Research methods:** How did you gather your data? What equipment did you use? How often did you collect your data?
3. **Results and Interpretation:** What did you find? Were there any trends? Do your data support your hypothesis or not?
4. **Conclusions:** What recommendations do you have for further research?

These elements do not necessarily have to be presented in the order shown above. Your Abstract should be 200-250 words in length. Spelling and grammar count - proof and edit your text carefully

Peer Review

Each group will review other groups' abstracts and have other groups review and edit their abstract. Why are we having you do this? Peer review is an important part of the scientific community. Before being published in a scholarly journal, articles must undergo the peer review process. Your review of another groups abstract will give them an outside perspective and will challenge you to think about the components of your abstract.

Please refer to the Abstract Peer Review Rubric to know how your abstract will be evaluated.

Abstract Peer Review Rubric

| | 5 | 3 | 1 |
|-------------------------------------|--|--|---|
| Clarity of Research Question | <ul style="list-style-type: none"> Clearly identifies the research question and its inherent complexities Identifies a study that is feasible and testable | <ul style="list-style-type: none"> Identifies a research question Identifies a study that is feasible and/or testable. | <ul style="list-style-type: none"> Does not clearly identify a research question or line of study. Gaps in feasibility and testability were evident from the outset. |
| Identifies Rationale and Hypothesis | <ul style="list-style-type: none"> Very clearly identifies a hypothesis and rationale Explicitly draws support for his/her rationale from experience, observation, and/or the literature base. Most variables are thoughtfully identified. | <ul style="list-style-type: none"> Identifies a hypothesis and/or rationale Limited support for the rationale Some variables are identified | <ul style="list-style-type: none"> Hypothesis and/or rationale not identified or inconsistent. Does not support rationale Variables are inadequately addressed |
| Design of Methodology | <ul style="list-style-type: none"> Clear and complete description of steps that will achieve the purpose of the research study and detailed enough to allow for replication of the study. | <ul style="list-style-type: none"> Designs an appropriate methodology to achieve the purpose of the study including procedures and instrumentation. Description of steps for research study are included. | <ul style="list-style-type: none"> Methodology is confusing or contains gaps. Methodology will not achieve the intended purpose of the study. Does not include description of steps for research study. |
| Conclusions | <ul style="list-style-type: none"> Clearly addresses the research question(s). Draws inferences that are highly consistent with the data and scientific reasoning Identifies well-reasoned directions for future research. Explicitly discusses limitations. | <ul style="list-style-type: none"> Addresses the research question(s). Identifies conclusions based on observation. Attempts to identify directions for future research Defines limitations in broad terms | <ul style="list-style-type: none"> Conclusions do not address the research question(s). Conclusions not evaluated for accuracy and precision. Does not identify future directions Does not identify limitations |

Instructions:

Circle the bullet point that you think matches the abstract you are evaluating.

Write a total score based on your evaluation for each category in the left-most column.

Provide detailed comments. A simple comment like "good or bad job on your discussion," doesn't teach the writer very much about their abstract. Being specific like, "I would have liked to have read more about the process you used to measure Chloride levels."

Calculate a total score for the abstract and provide overall comments.

Poster Presentation Overview

Your group will give a poster presentation summarizing the results of your research. Your grade will be based on three components: 1) Your class presentation graded by your TA. This will be an individual grade and worth 5 points. 2) Evaluation of your poster by your TA. This will be a group grade and worth 30 points. 3) Evaluation of your poster by a team of faculty members from Iowa State University and professionals from the Ames community. This will be a group grade and worth 10 points.

Your poster should be of professional quality. If you are unsure of what this means, wander the hallways of Science 1 and view some of the posters made by undergraduate and graduate students. Student posters from previous semesters are posted in the hallway as well.

A copy of the rubric that will be used to judge your poster and its content will be available on Blackboard.

Your poster should include the following components:

- Your research question and hypothesis that you set off to test
- Background of your research including previous research work that you read to prepare for your project
- Research Methods: How you gathered your data, what equipment you used, and your research methodology (e.g. when and how often you collected your data)
- Results: a summary of the data you collected and your findings
- Interpretation: how do the data you collected help answer your initial hypothesis?
- Conclusions: What did you learn from your research experience? What further research needs to be done?
- Abstract: The abstract is a 200-250 word summary of everything above and it will go at the top of your poster, right under the title and authors. It should include the research question, your hypothesis, methods, results, and interpretation
- Learning points: The three most important things (e.g., content, nature of science, basic skills) that you learned through this project and that you found especially useful.

Helpful suggestions:

- If you choose to include charts, graphs, or images, make sure they relate to your topic
- Include at least one map showing the location(s) of your measurements.
- Don't fill your whole poster with text and graphics—less is more. Include the information you need, but be concise
- Make sure your text can be read from 3 feet away (i.e., use large font sizes)

Your posters should be 48in wide and 36in tall and in color. The department will cover the cost of printing your poster **if you submit a copy of your poster via email or flash drive.** If you do not submit your poster by the due date, your group will be responsible for printing and covering the cost of your poster.

Your TA will grade your in-class presentation of your research using the following rubric. You will receive an individual grade of 5 points for how well you present your research. Your group will also receive a grade based upon the content of your poster. See the Poster Overview for more details.

| | 5 | 3 | 1 |
|---|---|---|---|
| Content Knowledge Points: | <ul style="list-style-type: none"> • Well-developed understanding of groundwater concepts. • Well-developed understanding of project components. | <ul style="list-style-type: none"> • Understanding of groundwater concepts • Understanding of most project components. | <ul style="list-style-type: none"> • Inaccuracies or large gaps in understanding of groundwater concepts. • Inaccuracies or large gaps in understanding project components. |
| Oral Presentation Skills Points: | <ul style="list-style-type: none"> • Exhibits exemplary professional demeanor • High level of poise • Communicates high level of preparation for the presentation. • Communicates an enthusiasm or strong scholarly interest in the subject manner. • Handles questions from the audience with confidence • Rate of speech (or presentation) facilitates audience understanding | <ul style="list-style-type: none"> • Exhibits professional demeanor • Maintains composure throughout the presentation. • Communicates competent level of preparation. • Communicates a desire to perform well • Communicates willingness to interact with the audience. • Rate of speech (or presentation) does not detract from audience understanding | <ul style="list-style-type: none"> • Does not exhibit professional demeanor • Composure is lost during presentation. • Seems unprepared • Communicates little interest in the subject manner. • Lackadaisical attitude is evident. • Rate of speech (or presentation) detracts from audience understanding. |

This rubric will be used by your TA to grade your poster. It will also be used by faculty and staff judges at the evening poster session.

| | 5 | 3 | 1 |
|---|---|--|---|
| <p>Clarity of Research Question</p> <p>Points:</p> | <ul style="list-style-type: none"> Clearly identifies the research question and its inherent complexities Identifies a study that is feasible and testable | <ul style="list-style-type: none"> Identifies a research question Identifies a study that is feasible and/or testable. | <ul style="list-style-type: none"> Does not clearly identify a research question or line of study. Gaps in feasibility and testability were evident from the outset. |
| <p>Identifies Rationale and Hypothesis</p> <p>Points:</p> | <ul style="list-style-type: none"> Very clearly identifies a hypothesis and rationale Explicitly draws support for his/her rationale from experience, observation, and/or the literature base. Most variables are thoughtfully identified. | <ul style="list-style-type: none"> Identifies a hypothesis and/or rationale Limited support for the rationale Some variables are identified. | <ul style="list-style-type: none"> Hypothesis and/or rationale not identified or inconsistent. Does not support rationale Variables are inadequately addressed |
| <p>Design of Methodology</p> <p>Points:</p> | <ul style="list-style-type: none"> Clear and complete description of steps that will achieve the purpose of the research study and detailed enough to allow for replication of the study. | <ul style="list-style-type: none"> Designs an appropriate methodology to achieve the purpose of the study including procedures and instrumentation. Description of steps for research study are included. | <ul style="list-style-type: none"> Methodology is confusing or contains gaps. Methodology will not achieve the intended purpose of the study. Does not include description of steps for research study. |
| <p>Data Presentation</p> <p>Points:</p> | <ul style="list-style-type: none"> Highly consistent and appropriate use of scientific units of measurement, labels, symbols, and equations. Concise visuals convey pertinent data that are otherwise difficult to convey; thus, increasing the efficiency and effectiveness of the presentation. Visuals enhance the communication process by utilizing the appropriate balance between effective visuals and text. | <ul style="list-style-type: none"> Consistent use of scientific labels, units of measurement, symbols, and equations. Minor inaccuracies or omissions noted, such as skipping a step, inaccurate equation (e.g., lack of labels, typographical errors, etc.) Visuals convey data that are pertinent and add to the presentation, with some balance between text and visuals | <ul style="list-style-type: none"> Does not attempt to use scientific labels, symbols, or equations. Major inaccuracies or omissions are noted. Visuals distract from presentation by being too wordy or too limited (e.g., too much text or visual) |

| | 5 | 3 | 1 |
|---------------------------------------|--|--|---|
| Data Collection & Analysis Points: | <ul style="list-style-type: none"> • Very appropriate use of instruments & tools to make careful measurements. | <ul style="list-style-type: none"> • Appropriate use of instruments & tools to make careful measurements. | <ul style="list-style-type: none"> • Inappropriate use of tools & instruments. |
| Accuracy & Precision Points: | <ul style="list-style-type: none"> • Evaluates the accuracy & precision of the data. • Clearly examines the evidence and identifies specific sources of error and determines means for reducing error in future studies. | <ul style="list-style-type: none"> • Examines the evidence and identifies error in general terms. • Notes that there may be some inconsistencies in data but explanation is not developed. | <ul style="list-style-type: none"> • Conclusions are not evaluated for accuracy and precision • Sources of error are not identified. |
| Conclusions Points: | <ul style="list-style-type: none"> • Clearly addresses the research question(s). • Draws inferences that are highly consistent with the data and scientific reasoning • Identifies well-reasoned directions for future research. • Explicitly discusses limitations. | <ul style="list-style-type: none"> • Addresses the research question(s). • Identifies conclusions based on observation. • Attempts to identify directions for future research • Defines limitations in broad terms | <ul style="list-style-type: none"> • Conclusions do not address the research question(s). • Conclusions not evaluated for accuracy and precision. • Does not identify future directions • Does not identify limitations |
| Organization & Sequence Points: | <ul style="list-style-type: none"> • Clearly organized and logical using format of commonly accepted scientific literature. • Explicitly differentiates main from secondary ideas. | <ul style="list-style-type: none"> • Organized, using clear divisions of the segments within the presentation. • Main ideas are emphasized. | <ul style="list-style-type: none"> • Format is disorganized. • Main ideas are lost |
| Writing Conventions Points: | <ul style="list-style-type: none"> • Very consistent use of discipline specific language AND • Excellent quality of writing | <ul style="list-style-type: none"> • Attempts to use discipline specific language AND • Competent quality of writing | <ul style="list-style-type: none"> • Does not attempt to use discipline specific language AND • Unacceptable quality of writing |
| Content Knowledge Points: | <ul style="list-style-type: none"> • Well-developed understanding of groundwater concepts. • Well-developed understanding of project components. | <ul style="list-style-type: none"> • Understanding of groundwater concepts • Understanding of most project components. | <ul style="list-style-type: none"> • Inaccuracies or large gaps in understanding of groundwater concepts. • Inaccuracies or large gaps in understanding project components. |